DEBRIS COLLECTING TECHNOLOGY

This application claims the benefit of U.S. Provisional Application No. 60/235,658, filed September 26,2000

FIELD OF THE INVENTION

The present invention relates generally to the collection of debris from a variety of surfaces. Such a debris collecting system could be a stand-alone unit or part of a larger system employing secondary/auxiliary collection systems such as a vacuum.

BACKGROUND OF THE INVENTION

In the art of garment care it is known that manual combing of fabric with bristles of oriented fabric can be used to collect and clean for example see patent #4,850,073 It is also common knowledge to use a vacuum system employing agitation systems using rotary brushes and beater bars to clean a variety of surfaces. It is also known that various methods of cleaning webs of fabrics are known. And it is also known that there are several methods that rely on a sticky surface, which is either adhesive coated, or made of a tacky polymer have been employed to clean surfaces. It is also known that a surface comprised of extending fibers or bristles that are biased, or directional have been used to collect and hold such debris. There are limitations to all of these methods though. Either the format is only suitable for large-scale cleaning of surfaces, or the solutions to date

have been manual, limited in cleaning capacity, and lacking the advantages and efficiency that automation brings to most tasks.

SUMMERY OF THE INVENTION

The present invention is intended to provide an improved means of collecting and removing various types of debris from various types of surfaces. One aspect of this invention is directed at, but not limited to, the removal of lint, thread and various other types of debris that often is found on fabric, clothing, drapery, furniture, and carpeting. Another aspect of this invention is directed at, but not limited to, the cleaning and dusting (or de-dusting) of hard surfaces found throughout the home and workplace such as flooring, hard surfaces of furniture/tabletops, walls, etc. This invention relates to both an isolated collection system, and to that would be used in conjunction with other commonly used collection devices such as a vacuum, but is not limited to having to rely on a vacuum.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side schematic view illustrating the operating principles of the invention.

Figure 2 is a side schematic view further illustrating the operating principles of the invention.

Figure 3 is a side schematic view further illustrating the operating principles of the invention.

Figures 4 through 10 are side schematic views further illustrating the operating principles of the invention.

Figure 11 is a trimetric view of the invention.

Figure 12 is a sectional trimetric view of the invention, depicting the inner workings.

Figure 13 is a trimetric view of one form of roller, primary or secondary.

Figure 14 is a side view of the secondary roller of figure 13.

Figure 15 is a trimetric view of another form of roller, primary or secondary.

Figure 16 is a side view of the secondary roller of figure 15.

Figure 17 is a side sectional view of one embodiment of the invention.

Figure 18 is a front sectional of one embodiment of the invention.

Figure 19 is a side schematic of an embodiment of the invention illustrating the use of an ancillary surface/roller.

Figure 20 is a side schematic of an embodiment of the invention illustrating the use of an air-tubine motor.

The following reference characters are used in the drawings of refer to the parts of the present invention. Like reference characters indicate like or corresponding parts in the respective views.

2- Main moving surface

4-Secondary debris removal surface

6-Debris

8- Secondary debris removal surface with alternate form

10- Secondary moving surface

12-Debris collection area

14-Access door

16-Latch

18-Switch

20-Housing

22-Reduction gearbox

24-Motor

26-Spur gear

28-Spur gear

30-Wiring

32-Batteries

34-Pivot point

36-Spur gear

38-Finger

40-Fin

42-Pivot point

44-Pivot hole

46-Vacuum port hole/inlet

47- Ancillary moving surface

49- Air turbine impeller.

51- Drive belt

DETAILED DESCRIPTION OF THE INVENTION

While the invention will be described in connection with several preferred embodiments, it will be understood that the invention is not limited to these embodiments. On the contrary, the invention includes all alternatives, modifications, and equivalents as may be included within the spirit and scope of the appended claims.

In the art of debris removal, from a variety of surfaces found in daily life, there are several approaches. The first of which is to use a vacuum to effect enough air movement to collect the debris. The problem with this is that often the air movement alone is not enough to dislodge the debris and free it from the surface to be cleaned. There are also vacuum systems employing agitation systems using brushes, rotary brushes and beater bars to clean a variety of surfaces. The problem here lies in the fact that on hard surfaces, such as flooring, the action of the rotary brush often blows hair, lint and other debris to be collected away from the collecting device. Also, the bristles and their powered movement can scratch and mar certain surfaces. In the case of upholstery or carpeting, the action of the brushes is often not enough to free the debris from the holding tension of the upholstered/carpeted surface so that the air movement of the vacuum can do its job. Additionally, once a brush does grab certain types of debris such as hair and thread, it is unable to release it and so after a short while the brush itself becomes fouled, bound with debris, and needs to be cleaned.

It is also known to use a "sticky" surface most often in the form of a roller to clean the surface to be cleaned. The stickiness of this surface is either created by adhesive applied to a paper or similar backing, like a roll of tape wound backwards, or the stickiness is created by the tacky qualities of a polymer surface. In the case of the former approach, the "tape" surface quickly becomes fouled and a fresh surface must be effected so that any new debris can be picked up. In the case of the latter, the tacky polymer surface must be rinsed with water and then subsequently dried, after the surface has been fouled. Another method that is commonly employed is to use a fabric with a directional bias mounted to a handle. The brush is moved along the surface to be cleaned in a

direction opposite to the "grain" of the pile of the fabric, thus entrapping the debris in those biased bristles. To clean the fouled surface, the user the moves the cleaning surface in an opposite relative direction on a third cleaning surface, most often a waste piece of fabric. Also in the art of debris removal, there are devices that use relatively long extending fibers. These range from feather dusters, to dust mops. Both of these often brush dirt around once they have held their capacity. Also in the art of debris removal, there are devices that use fibers that do not extend appreciably, but instead are woven to entrap and hold, such as dusting cloths. These too push dirt around once they have held their capacity. Obviously, the problems with all of the aforementioned solutions are numerous, the most common being the limited capacity that each has before "maintenance" is required. But another is the fact that once the surface becomes slightly fouled an interesting phenomenon occurs. For every X number or so fibers or debris that are collected, a couple of previously collected ones are released because they are not properly held, as those that are held by a fresh surface. So the ultimate solution lies in presenting the surface to be cleaned with a fresh clean unfouled surface to effect the cleaning action.

There are several features that are common to all the embodiments. A moving primary cleaning surface is used in all cases, as is a secondary surface that cleans the primary surface. The moving primary cleaning surface cleans the surface to be cleaned and the secondary surface cleans the primary cleaning surface, and optionally, moves the collected debris to a third collection area.

As defined herin, a "moving" surface is defined as a surface that normally moves when the present device is in use. An "endless moving surface" is defined as a moving

surface having one or more elements that normally periodically traverses an established closed path and thus regularly returns to any point on the path without stopping. A reciprocating surface is a moving surface that moves back and forth along a straight or curved path, usually (but not necessarily) stopping momentarily at each end of its travel. In other words the endless moving surfaces may have several different forms. One such form is a rigid or flexible cylindrical roller rotatable about its axis. Another such form is a belt defining a surface and carried on one or more rollers or other structure. Yet another such form is a flexible, rotating disk adapted to be disposed at an angle to a surface with a portion of the disk on one side of its center of rotation pressed into contact with the surface and thus bent out of plane of the disk (much as a flexible sanding disk is used). Another form of moving surfaces contemplated herin is a reciprocating surface, which may reciprocate in a straight line of along a curved path.

The main moving surface, reference character 2 in the illustrations, has a surface that has the characteristics that make so that it has the ability to grab and hold debris. (As previously stated some examples of moving surfaces are: rollers, belts, and disks) This outside surface may be comprised of fabric, bristles, fibers, or a surface with tacky characteristics such as a plastic polymer or adhesive tape surface may exhibit. So the primary cleaning surface may take many forms, ranging from a dust cloth type of material to one which is a brush that could be made of bristles, to another is that of bristle-fibers as one would find on a manual "lint-brush", and yet another is the projections one encounters on the many types of manual dusters made of materials such as feathers or long nylon fibers. Any of the aforementioned surfaces may have the additional and in some cases preferred characteristic of being directional in nature. One

type of such orientation is one where the fibers or relief is such that all are angled in a non-perpendicular fashion. Analogies are: shingles on a roof, scales on a fish, or feathers on a bird. When brushed against the grain, the projecting elements ruffle and then can entrap loose elements. It may be desirable to construct the main roller with flaps or fins either radially, or perpendicular to its axis of rotation. These flaps may or may not have the surface relief options previously mentioned.

Another feature common to all embodiments is a secondary surface, which has the ability to remove the debris from the primary surface. This secondary surface may take the form of a static surface such as a block or a comb structure, or it may take the form of a dynamically moving surface such as a rotating roller ,a moving belts, or moving disks, or reciprocating surface. In addition to cleaning the primary surface, the secondary surface may also, either frictionally through the materials selected, or through electrical means, impart a static charge to the primary roller enhancing the primary rollers' ability to gather debris. A static charge, by electrical, or frictional means could also be imparted through either roller either contacting or being in close proximity to another static generating element of the device. In any case, it could be desirable to introduce a static charge into the equation, if only through the material selected for the primary roller.

Referring to Figure 1, one embodiment of the invention is illustrated where the primary moving surface, 2, is a cylinder. After rotating and picking up debris, the secondary debris removal surface, 4, removes the collected debris, 6, from 2.
This secondary debris removal surface may take many forms, and be made of several varying materials. The forms could range from the block depicted in Figure 1 to a form that resembles a comb, which is best illustrated in figures 3 and 4. The primary surface

may be powered through conventional means such as a motor and associated gearing and/or belt drives. The motor could be electrical in nature, a mechanical wind-up spring driven motor, or an air-turbine motor powered by an on board or separate, external air movement device such as a vacuum fan . The primary surface may also be powered by the operator moving the device on the surface to be cleaned. Drive wheels and associated means may be provided, much in the same way a manual floor sweeper operates, to convert the movement of the machine relative to the surface to be cleaned into the required/desired motion of the primary/secondary surfaces. The primary surface may also be powered by the operator moving a crank, hand wheel, or other means to intermittently or constantly power the device. So any type of motor or known powering means could be employed to activate the unit.

The major differences between figures one through four, and five through ten concern the rotary movement of the secondary surface relative to the rest of the machine. Figures one and two relate to a machine with a static or non-rotating secondary surface. This second static surface may have some elements of movement however, such as a biased vertical movement to maintain a given pressure against the main roller. This biased movement could be achieved through either the primary or secondary surface being biased against the other through the use of spring loading, or through the resiliency of the materials each is constructed of.

The primary moving surface may rotate, or move, in either direction, however, depending upon its composition and construction, and the form (static or dynamic) some directional combinations may be preferred. In the cases where a relatively consistent non-directional surface composition is used, in conjunction with a static secondary surface,

directional considerations are negligible. In the case where the primary surface has a directional bias, and the secondary surface is relatively non-moving, it may be preferred to have the main roller rotate, or move, so that the secondary surface interacts with the primary surface with the grain as is depicted in figures two and four. This results in reduced power consumption and makes it easier to remove the debris from the roller. If the main roller were to rotate in the direction of figures one and three it would have to overcome the forces caused if the primary surface is directional in nature. Additionally, tolerances can be relaxed between the main roller and the housing removing the possibility of the grain "catching" the edge of the housing if the primary surface is directional in nature.

Referring to Figures three and four, another embodiment of the invention is illustrated. In this embodiment after the moving surface, 2, rotates and picks up debris, the secondary debris removal surface, 8, removes the collected debris, 6, from 2. This embodiment simply illustrates an alternative form for the secondary surface, 8, such as may be if the secondary surface had the form of tines of a comb.

Referring to Figures 5 through 10, another embodiment of this invention is of the invention is illustrated. In this embodiment the secondary surface is dynamic in nature. It will be appreciated the advantages that can be gained through making the secondary surface dynamic in nature. In the illustrated embodiment the secondary surface is rotationally dynamic. The rotation can be achieved using the same primary motivational means as have already been mentioned, electric or mechanical.

The relative movements of the rollers may take several formats. Figure seven depicts a primary roller moving opposite to that in figure five, and a secondary roller

moving in the same direction as it does in figure five. The primary difference between the two configurations lies in the way that the secondary roller interacts with debris picked up on the primary roller. The directional orientation found in figure five results in the secondary roller first encountering the piece of debris on the "front-end" causing the secondary roller having to pull the debris forward off the roller as best depicted in figure 6. In figure seven, the secondary roller always encounters a piece of debris at the "backside" of the grain of the oriented fabric, best depicted in figure eight. Although the rotation of figure five works because of the fact that the secondary roller is rotating at an effective surface speed greater than the primary roller, it is not as preferred as the relative rotations found in figures six and eight. Additionally, once the debris is "freed" initially from the surface of the main roller in figure five and six, the main roller/surface has a tendency to again catch the debris on the other side (right in figure fiveand six) and, because of its relative rotation, carry it around on its surface for another revolution. In contrast, the scenario set forth in figure seven and eight, has not only the characteristic of encountering the debris on the backside of the grain, but also because of the relative rotations, the differential in surface speeds is exacerbated causing the debris to be balled and almost thrown from the primary surface. Additionally, because of the relative rotations, loosened debris caught again by the primary surface is not allowed to be carried away from the secondary surface, and thus refoul the surface to be cleaned. These different configurations as far as relative rotations can be achieved through several means. One is to vary the number of gears between the primary roller and the secondary roller and thus the drive. Another is to use a belt drive between the primary and the secondary roller and thus the drive. This belt could either be of a normal straight-line

configuration, or twisted in a figure eight form to achieve relative rotation opposite that of a straight line drive. Another configuration is to simply power the two drives with two separate motors or drives. Another aspect that is contemplated is to have means to alter the time of contact relative to the primary and secondary surfaces, imparting an intermittent contact interval. This would enable the surfaces to not be in constant contact with each other. Another aspect that is contemplated is to have means to alter the time of motion relative to the primary and secondary surfaces, imparting an intermittent motion interval. In other words, if the secondary surfaces contemplated have motion or movement relative to the primary surface, this motion may be intermittent between the two. This would enable a secondary surface such a comb, block or endless surface to have intermittent motion, and impart a "kicker" action relative to the primary surface. These motion options could be combined and either user defined, such as through the use of a lever or button, or they could be mechanically defined through the use of commonly known methods such as cams, linkages, Geneva arrangements, etc.

It may be advantageous to make the primary surface a core with a layer of foam or other resilient surface and then clad the foam with the final pick-up layer. This would serve to give the primary surface a resiliency relative to the surface to be cleaned, as well as, a resiliency to the secondary debris removal surface/roller. This allows for a contouring effect, which relaxes the relative tolerances of the surfaces. Equally, the primary surface could be of a composition/material or geometry (length of fibers etc.) as to constitute an appropriate level of surface compensation.

It in some cases is also advantageous to construct the primary roller with "breaker-strips', or areas or strips or spirals that are absent or devoid of that outer pick-up surface. The reason for this is similar to that previously mentioned in that it provides for an area where the main roller cannot re-pick-up debris released by the secondary surface/roller, and so the debris is more readily deposited in the waste area. Figures nine and ten further illustrate previously discussed embodiments with the addition of a waste collection area-12.

The secondary surface/rollers may take several forms. The surface/roller can be as simple as a surface with a coefficient of friction, relative to the surface of the main roller, high enough to be effective. This can be accomplished simply through the materials selected, as well as through surface configurations. Surface configurations can vary from a textured surface analogous to a "sandblasted" surface to configured surfaces. Examples of configured surfaces can be found in figures 13-16. Secondary surfaces may take the form of a flap-surface or flap roller as best depicted in figures 13,14. The secondary surface could also take the form of a "fingered" roller, similar to a cylindrical hairbrush as best depicted in figures 15 and 16. Any of these configurations could have their protuberances either relatively straight or angled to achieve the desired results. All of these "intermittent" configurations have the advantages of being self-adjusting with regard to tolerances and lowered drag, which results in lower power consumption.

For reasons already discussed concerning the primary pick-up surface, it may also be advantageous to make any of the secondary surfaces previously mentioned as a rigid core with a layer of foam or other resilient surface and then the final pick-up layer.

Another configuration is to have the primary and secondary rollers or surfaces biased against each other by a spring or other means. One such means, in the case of a belt-driven system, is to use the resiliency of the belts themselves to provide a biasing force between the two rollers. One or both of the rollers would be able to move (center to center distances) relative to the other such as could be achieved through a journaled pivot-point arrangement. At any rate, it could be advantageous to bias the two rollers relative to their center-to-center distances. All of these configurations address the situation of a self-adjusting system that compensates for tolerances encountered in manufacturing and normal wear of a product.

In addition to the two main rollers already discussed, other ancillary rollers may be employed. The reason for this is simple, getting some forms of debris from the surface to be cleaned into the debris collection area is sometimes analogous to the situation we have all encountered with a piece of sticky tape. Despite your best efforts, for a time it is all one can do to just transfer the tape from finger to finger (or surface to surface) until it finally lets go. So, it may be of some advantage to transfer the collected debris from roller to roller, or surface-to-surface until it, the debris, is directed to its final destination. This surface like other secondary surfaces discussed, could be relatively static or dynamic in nature. An example of an additional surface, in this case a dynamic roller, is depicted in figure 19.

Another embodiment provides a means for a vacuum or power fan assist. Once the primary and secondary surfaces have loosened and initially displaced the debris, even

the slightest air movement can clear the debris off the secondary or ancillary rollers. This air movement could be achieved through a mechanism inherent to the device such as an internal fan, or through a secondary device such as a household vacuum. If a motor were inherent to the device, it may be desirable, in the interest of efficiency, to use only the exhaust air from the motor to provide the aforementioned functions. If a secondary device such as an external vacuum is used, such a secondary device could be attached via a port such as # 46 in figure #11. The advantage of using a secondary device, in addition to the easier clearing the rollers, is to provide increased collection (in quantity) capabilities to that that may be achievable in a geometry that the unit may assume. Additionally, as previously noted, if an external vacuum were used, the unit could be powered by an air turbine-motor obviating the need for additional mechanisms, batteries, etc. One such arrangement can be seen by referring to figure 20

There are several modes of operation that may be desirable. The first is where the motor is energized for the entire time the machine is being used. In this way, the primary surface is being cleaned constantly, and thus the user is constantly using a fresh cleaning element. A second mode of operation contemplates the user brushing the surface to be cleaned with the unit "off", and then turning the machine on for a short period to clear the primary cleaning surface. This could have the twofold advantage of power consumption and reduces wear of all the components. Yet another mode is to have the machine rotating in "reverse" to its optimized relative movements, and then have the relative movements move in the opposite direction to that "reverse" mode previously mentioned so that now the clearing of the primary surface is optimized. Thus an improved method for collecting many types of debris from various types of surfaces has been disclosed.